FUSION CHANNEL OF pd CHARGE-SYMMETRIC ION INCLUDING PHOTONS

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ABSTRACT

The charge- symmetric pseudo nucleus pd is formed in the cascade processes in the muon catalyzed fusion. The nuclear fusion in $pd\mu$ ion can be considered in the photon field. For the spin states of pd (L=0) system, employing a new space wave function of three-body, the matrix element M1 proportional to

$$S_{S_{pd}} = \frac{\pi\alpha^2 m_{pd}\omega^3}{3(2S_{pd}+1)m_p^2}\left|\left\langle {}^3He \left| M1 \right| pd ; L=0, S_{pd} \right\rangle\right|^2 \quad (1)$$

and the fusion rate

$$\lambda^{\gamma}_{S_{pd}} = \frac{S_{S_{pd}}}{\pi\alpha m_{pd}}\rho_{pd\mu}, \rho_{pd\mu} = \int\left|\psi_{pd\mu}(\vec{R}=0,\vec{r})\right|^2 d\vec{r} \quad (2)$$

for its ground state are calculated. The used wave function is introduced in the form of

$$\psi_{pd\mu}(\vec{r},\vec{R}) = \Re(R)\{\xi_{d_\gamma}\tau^{-\frac{1}{2}}(\gamma,\gamma')\times\exp(-|\gamma\vec{r}+\gamma'\vec{R}|)+\xi_{d_\beta}\eta^{-\frac{1}{2}}(\beta,\beta')\times\exp(-|\beta\vec{r}+\beta'\vec{R}|)\}\chi^{0,0}(R)Y_{0,0}. \quad (3)$$

The nuclear wave function $\chi^{0,0}(R)Y_{0,0}$ is numerically calculated considering Wood-Saxon potential in the total Hamiltonian of the mentioned system. The good behavior of $\Re(R)$ is caused that our works are easily done in a short computation time. This function is linear from R =0 to $2.2\times10^{-10}cm$ and then, is limited to 0.7068. The constant parameters of nuclear potential are obtained as well as those of the introduced wave function, when the boundary conditions are satisfied in our calculations. Notice that the notations $(\vec{R},\vec{r})$ are Jacobean coordinates. The radiative pd fusion rates for the two spin states in the pdμ mesic molecule are found to be $\lambda^{\gamma}_{1/2} = 0.42\mu s^{-1}$ and $\lambda^{\gamma}_{3/2} = 0.13\mu s^{-1}$, close to experimental data.